

GEPHE SUMMARY

RYR (https://www.gephebase.org/search-criteria?/and+GeneGephebase=R^YR^#gephebase-summary-title)	Gephebase Gene	GP00002433	GepheID
Published	Entry Status	Courtier	Main curator

PHENOTYPIC CHANGE

Physiology (https://www.gephebase.org/search-criteria?/and+TraitCategory=Physiology^#gephebase-summary-title)	Trait Category		
Xenobiotic resistance (insecticide ; diamide ; chlorantraniliprole ; flubendiamide) (https://www.gephebase.org/search-criteria?/and+Trait=Xenobiotic resistance (insecticide ; diamide ; chlorantraniliprole ; flubendiamide)^#gephebase-summary-title)	Trait		
Plutella xylostella - susceptible	Trait State in Taxon A		
Plutella xylostella - resistant strain ThaiR	Trait State in Taxon B		
Taxon A	Ancestral State		
Intraspecific (https://www.gephebase.org/search-criteria?/and+TaxonomicStatus=Intraspecific^#gephebase-summary-title)	Taxonomic Status		
	Taxon A	Taxon B	
Plutella xylostella (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=Plutella xylostella^#gephebase-summary-title)	Latin Name	Plutella xylostella (https://www.gephebase.org/search-criteria?/and+Taxon and Synonyms=Plutella xylostella^#gephebase-summary-title)	Latin Name
diamondback moth	Common Name	diamondback moth	Common Name
diamondback moth; cabbage moth; Plutella xylostella (Linnaeus, 1758); Putella xylostella	Synonyms	diamondback moth; cabbage moth; Plutella xylostella (Linnaeus, 1758); Putella xylostella	Synonyms
species	Rank	species	Rank
cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Protostomia; Ecdysozoa; Panarthropoda; Arthropoda; Mandibulata; Pancrustacea; Hexapoda; Insecta; Dicondylia; Pterygota; Neoptera; Holometabola; Amphimesnoptera; Lepidoptera; Glossata; Neolepidoptera; Heteroneura; Dityrsia; Yponomeutoidea; Plutellidae; Plutella	Lineage	cellular organisms; Eukaryota; Opisthokonta; Metazoa; Eumetazoa; Bilateria; Protostomia; Ecdysozoa; Panarthropoda; Arthropoda; Mandibulata; Pancrustacea; Hexapoda; Insecta; Dicondylia; Pterygota; Neoptera; Holometabola; Amphimesnoptera; Lepidoptera; Glossata; Neolepidoptera; Heteroneura; Dityrsia; Yponomeutoidea; Plutellidae; Plutella	Lineage
Plutella () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=51654)	Parent	Plutella () - (Rank: genus) (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=51654)	Parent
51655 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=51655)	NCBI Taxonomy ID	51655 (https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=51655)	NCBI Taxonomy ID
No	is Taxon A an Intraspecies?	Yes	is Taxon B an Intraspecies?
			Taxon B Description
			ThaiR : a field-collected diamide resistant strain collected from Bang Bua Thong in Thailand

GENOTYPIC CHANGE

RyR	Generic Gene Name	Q24498 (http://www.uniprot.org/uniprot/Q24498)	UniProtKB Drosophila melanogaster
RyR; CG10844; D-RyR; Dmel\CG10844; DmRyR; DRR; dry; DRY; dRyR; dRyR; dya; l(2)k00424; l(2)k04913; Rya-44F; Rya-r4; rya-r44F; Rya-r44F; Rya-R44F; Rya-r76CD; ryr; RYR; RyRs	Synonyms	()	GenebankID or UniProtKB
7227.FBpp0293114 (http://string-db.org/newstring.cgi/show_network_section.pl?identifier=7227.FBpp0293114)	String		
Belongs to the ryanodine receptor (TC 1.A.3.1) family.	Sequence Similarities		
GO:0005509 : calcium ion binding (https://www.ebi.ac.uk/QuickGO/term/GO:0005509)	GO - Molecular Function		
GO:0048763 : calcium-induced calcium release activity			

(<https://www.ebi.ac.uk/QuickGO/term/GO:0048763>)
 GO:0005219 : ryanodine-sensitive calcium-release channel activity
 (<https://www.ebi.ac.uk/QuickGO/term/GO:0005219>)

GO - Biological Process

GO:0006874 : cellular calcium ion homeostasis
 (<https://www.ebi.ac.uk/QuickGO/term/GO:0006874>)
 GO:0035206 : regulation of hemocyte proliferation
 (<https://www.ebi.ac.uk/QuickGO/term/GO:0035206>)
 GO:0006936 : muscle contraction (<https://www.ebi.ac.uk/QuickGO/term/GO:0006936>)
 GO:0006816 : calcium ion transport (<https://www.ebi.ac.uk/QuickGO/term/GO:0006816>)
 GO:0060047 : heart contraction (<https://www.ebi.ac.uk/QuickGO/term/GO:0060047>)
 GO:0072347 : response to anesthetic (<https://www.ebi.ac.uk/QuickGO/term/GO:0072347>)

GO - Cellular Component

GO:0016021 : integral component of membrane
 (<https://www.ebi.ac.uk/QuickGO/term/GO:0016021>)
 GO:0030659 : cytoplasmic vesicle membrane
 (<https://www.ebi.ac.uk/QuickGO/term/GO:0030659>)
 GO:0030018 : Z disc (<https://www.ebi.ac.uk/QuickGO/term/GO:0030018>)
 GO:0042383 : sarcolemma (<https://www.ebi.ac.uk/QuickGO/term/GO:0042383>)
 GO:0033017 : sarcoplasmic reticulum membrane
 (<https://www.ebi.ac.uk/QuickGO/term/GO:0033017>)
 GO:0005790 : smooth endoplasmic reticulum
 (<https://www.ebi.ac.uk/QuickGO/term/GO:0005790>)

Presumptive Null

No (<https://www.gephebase.org/search-criteria?/and+Presumptive Null=^No^#gephebase-summary-title>)

Molecular Type

Coding (<https://www.gephebase.org/search-criteria?/and+Molecular Type=^Coding^#gephebase-summary-title>)

Aberration Type

SNP (<https://www.gephebase.org/search-criteria?/and+Aberration Type=^SNP^#gephebase-summary-title>)

SNP Coding Change

Nonsynonymous

Molecular Details of the Mutation

G4946E

Experimental Evidence

Candidate Gene (<https://www.gephebase.org/search-criteria?/and+Experimental Evidence=^Candidate Gene^#gephebase-summary-title>)

	Taxon A	Taxon B	Position
Codon	GGG	GAG	-
Amino-acid	Gly	Glu	4946

Main Reference

Resistance to diamide insecticides in diamondback moth, *Plutella xylostella* (Lepidoptera: Plutellidae) is associated with a mutation in the membrane-spanning domain of the ryanodine receptor. (2012) (<https://pubmed.ncbi.nlm.nih.gov/22982600>)

Authors

Trocza B; Zimmer CT; Elias J; Schorn C; Bass C; Davies TG; Field LM; Williamson MS; Slater R; Nauen R

Abstract

Diamide insecticides such as chlorantraniliprole and flubendiamide are a new class of insecticide that selectively target insect ryanodine receptors (RyR), a distinct class of homo-tetrameric calcium release channels which play a pivotal role in calcium homeostasis in numerous cell types. Resistance to these insecticides has recently been reported in the diamondback moth, *Plutella xylostella* (Lepidoptera: Plutellidae), a global lepidopteran pest of cruciferous crops. In the present study a region of the gene encoding the proposed diamide binding site of the RyR from *P. xylostella* collected from the Philippines and Thailand and found to be over 200-fold resistant to both chlorantraniliprole and flubendiamide compared to susceptible strains, were amplified by RT-PCR and sequenced. Comparison of the sequence with those from several susceptible reference strains revealed non-synonymous mutations in each of the resistant strains that in both cases lead to a glycine to glutamic acid substitution (G4946E) in the protein. The independent evolution of the same amino acid substitution within a highly conserved region of the proposed diamide binding site in two geographically separated resistant strains of *P. xylostella* strongly suggests a causal association with diamide resistance. Furthermore we designed a pyrosequencing-based diagnostic assay for resistance monitoring purposes that can be used to detect the G4946E mutation in field-collected samples of diamondback moth. The implications of the reported findings for resistance management strategies are discussed.

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Additional References

Investigation of the contribution of RyR target-site mutations in diamide resistance by CRISPR/Cas9 genome modification in *Drosophila*. (2017) (<https://pubmed.ncbi.nlm.nih.gov/28669775>)

Functional analysis of a point mutation in the ryanodine receptor of *Plutella xylostella* (L.) associated with resistance to chlorantraniliprole. (2014) (<https://pubmed.ncbi.nlm.nih.gov/24030900>)

RELATED GEPHE

Related Genes

10 (ABCC2, Acetylcholinesterase (Ace-1), Chitin synthase 1 (CHS1), CYP6BG1, FMO2, glutamate-gated chloride channel (GluCl), MAP4K4, nAChR, para (kdr), resistance to dieldrin) (<https://www.gephebase.org/search-criteria?/or+Taxon ID=^51655^/and+Trait=Xenobiotic resistance/and+groupHaplotypes=true#gephebase-summary-title>)

Related Haplotypes

3 (<https://www.gephebase.org/search-criteria?/or+Gene Gephebase=RyR^/and+Taxon ID=^51655^/or+Gene Gephebase=RyR^/and+Taxon ID=^51655^#gephebase-summary-title>)

EXTERNAL LINKS

COMMENTS

@Parallelism - independent evolution of the same amino acid substitution (but different codon changes GGG>GAG and GGG>GAA) within a highly conserved region of the proposed diamide binding site in two geographically separated resistant strains of *P. xylostella*